

GRADES 3 & 4 — WHAT'S IN A FIELD?

NATIONAL SCIENCE STANDARDS

- Life Science: Organism and environment
- Life Science: Regulation and behavior

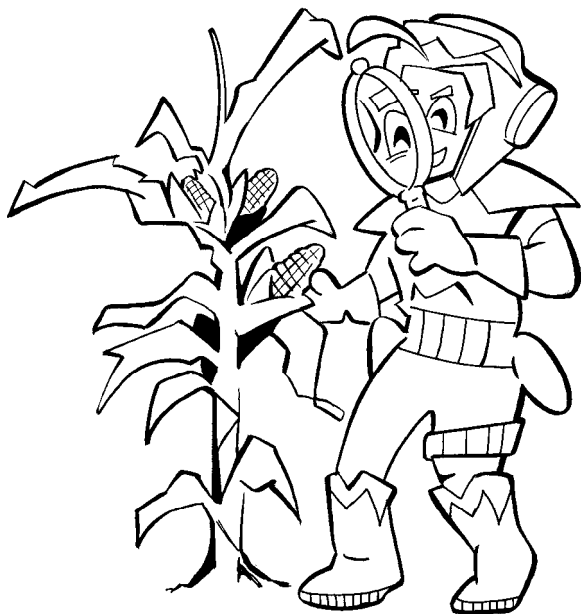
OBJECTIVE

The student will identify the effects of weeds and pests on farmers crops.

BACKGROUND

Technology is what allows the agricultural industry to address the natural science requirements of producing food with the social science events of less available farmland and an increasing population.

A plant needs nutrients, light, and air to grow. Farmers work very hard to maintain an ideal growing environment for the crops. Two natural factors that all farmers have to deal with are weeds and pests.



WORD POWER

dormant *adj.* When plants or seeds are dormant, they are alive but not growing.

insect *n.* A small creature with three pairs of legs, one or two pairs of wings, three main sections to its body, an exoskeleton, and not backbone.

pest *n.* An insect that destroys or damages flowers, fruits, vegetables or grains.

germinate *v.* When seeds of beans germinate, they start to grow shoots and roots.

weed *n.* An undesirable plant, especially one that growing where it is not wanted.

yield *n.* To produce something: *The field yielded 90 tons of potatoes.*

WHAT'S IN A FIELD? CONTINUED

BACKGROUND, CONTINUED...

The three main reasons weeds harm the farmer's crops resulting in less crop yields are:

1. A weed grows fast and tall. To support that fast growth, weeds rob the nutrients from the soil that are needed for the crop.
2. A common weed, thistle, can grow very quickly to be 10 feet tall. This weed and others can surround the farmer's plants blocking our needed sunlight.
3. Weeds block out needed air circulation. Proper air circulation is needed to prevent disease.



Weeds are constant problems for farmers because each acre of farmland in the U.S. contains millions of buried weed seeds. Many weed seeds can survive in a dormant condition in the soil for decades, and each year some seeds germinate. Once the weed has grown it will produce more seeds that will drop and remain in the soil.

Pests are always looking for food and would destroy almost half of the farmer's crop if they could. Weeds would decrease up to 65% of the amount of food grown.



INSTRUCTIONAL PROCEDURE

1. Review the background information.
2. Have the students complete Activity 1.

ASSESSMENT

Do the students understand why weeds decrease a farmer's productivity?

NAME _____

ACTIVITY 1 — WHERE'S THE CARROT?

CARROTS
GROWING
WITHOUT
WEEDS



CARROTS
GROWING
WITH
WEEDS

Carrots need nutrients from the soil, light from the sun and good air circulation to grow. If weeds are also using the same nutrients in the soil to grow what will happen to the carrots?

1. Will the weeds make it harder to harvest (pick) the carrots? YES or NO
2. Where are the weeds getting the nutrients necessary to grow?
 - a. from the air
 - b. from the soil
 - c. they do not need any nutrients to grow
 - d. from the rain
3. Because the **weeds** are using the available nutrients from the soil what effect might this have on the carrots.
 - a. there will be more carrots grown
 - b. there will be fewer carrots grown
 - c. the carrots will be smaller than normal
 - d. the carrots will be larger than normal
4. Weeds shade the carrot leaves. Without enough _____, the carrots cannot use the process of photosynthesis to produce food for growth.
 - a. food
 - b. sunlight
 - c. water

GRADES 4 & 5 — TECHNOLOGY OF AGRICULTURE

NATIONAL SCIENCE STANDARD

- Science and Technology: Abilities of technological design

NATIONAL SOCIAL SCIENCE STANDARD

- World History: Age of Revolutions-causes & consequences of the agricultural and industrial revolutions

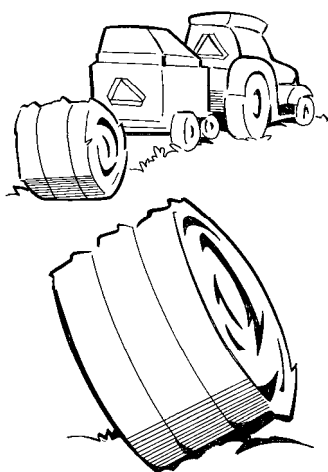
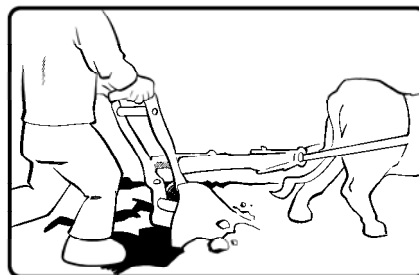
OBJECTIVES

The student will:

1. identify three forms of technology used in modern US agriculture: biotechnology, pesticides, and satellites.
2. understand how technology has helped the US change from an agricultural society to an industrial society.

BACKGROUND

In the mid 1800s the first industrial and agricultural revolution was taking off in the US. These revolutions involved the move from people growing their own food and providing their own needs to people specializing in trades and crafts that were sold to people outside their family.



Industrial and agricultural revolutions continued to evolve. A second Industrial Revolution (1910-1959) saw an increase in the manufacture of consumers goods. At the same time, the farming industry took its most rapid strides. The development of mechanized farm equipment and the electrification of farms caused an agricultural revolution which increased the yields of most farmers. In addition, in the 1940-50s a huge increase in the number of available pesticides decreased the number of crops lost to pests, which further increased the yield.

As the number of new industries developed at the same time that farming was requiring less labor, farmers had a wider choice of how to make a living.



BACKGROUND, CONTINUED...

From 1970 to today, advances in farming have included the improvement of pesticide use, scientific advancements in biotechnology, and space.

Pesticides

Pesticides have been used for centuries. Many newer pesticides are more effective in smaller quantities, less persistent in the environment and applied with greater care and concern for safety. Without pesticides, bugs would eat almost half of a farmer's crops. With pesticides bugs only eat 1/10th of a farmer's crop.



Biotechnology

Scientists can now create plants that have beneficial traits. The methods used to produce these new crops involve changing material within the crops called genes. Genes are in the cells of all living things. They guide how living things are made and how they function.

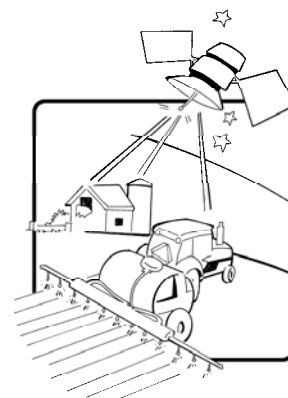


Scientists can create plants that are resistant to chemicals that kill weeds, plants that produce chemicals to kill insects, plants that can grow in poor dry soil, and plants that last longer after harvesting. By using biotechnology in this way, scientists are

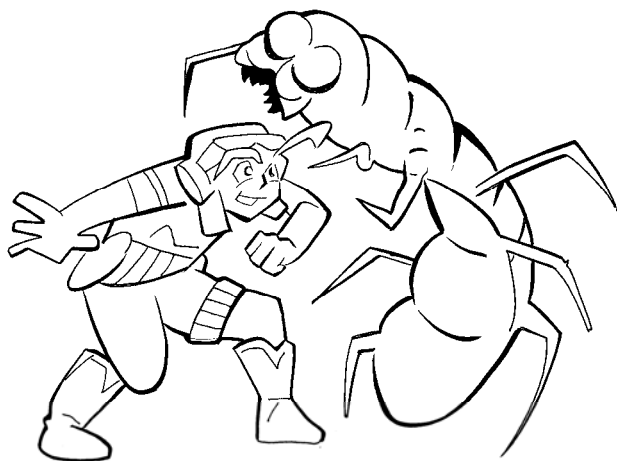
helping farmers grow more food on less land, which keeps the cost of food very low in the US.

Space

Global Positioning Satellites (GPS) uses a satellite in outer space to take special pictures of a farmer's field. These pictures can show a farmer how much fertilizer or pesticides needs to be applied in each small area of the field. The satellite then sends these pictures to the computer on the farmer's sprayer and tells it exactly how much fertilizer or pesticide to apply as it travels over the field.



The reason GPS is important is that a farmer's field is actually like a bunch of smaller fields put together. Different areas of the field have very different requirements for the soil. By applying the same amount of fertilizer or pesticides to the entire field, farmers might easily spray the areas of the field that don't need spraying. This is wasteful, expensive, and harmful to the environment.



INSTRUCTION PROCEDURE

1. Review background information.
2. Have the students complete “Agriculture and Technology” Activity 1
3. Do assessment 1.

ASSESSMENT

1. Using the pictures in the compare and contrast activity, have the students identify, analyze and compare the industry of farming including the tools, machinery, size, and role of the farmer.

WORD POWER

agricultural society *n.* A society in which crops are grown and people have specialized roles.

biotechnology *n.* Using scientific discoveries about living things to solve problems.

genes *n.* The part of a chromosome that determines one or more characteristics that living things inherit from their parents.

industrial society *n.* A society in which the production of food and other products is performed by machines, demanding large amounts of energy and resources.

pesticides *n.* Chemicals used to kill pests on crops.

satellite *n.* An object that orbits a planet and carries out a variety of jobs.

technology *n.* Using scientific discoveries and inventions to solve problems.

global positioning satellite (GPS) *n.* 24 satellites arranged so that several can be seen from any one point on Earth by radio at any given time. Radio signals from the satellites are then used to locate a position on Earth’s surface with greater accuracy.

NAME _____

ACTIVITY 1: AGRICULTURE AND TECHNOLOGY

FILL IN THE BLANKS

Technology is using scientific discoveries and inventions to solve problems. The United States leads the world in developing new technology.

Using the Word Bank at right, choose the correct word to complete each sentence.

1. Technology allows us to grow _____ food on _____ land.
2. Technology allows farmers to be gentler on the _____.
3. Technology allows farmers to _____ more people.

WORD BANK

- MORE
- LESS
- FEED
- ENVIRONMENT



NAME _____

ACTIVITY 1: AGRICULTURE AND TECHNOLOGY, CONTINUED

FILL IN THE BLANKS

In the past 100 years, the use of technology has changed the United States from an agricultural to industrial society.

- **Agricultural Society:** a community or nation where farming drives the economy.
- **Industrial Society:** a community or nation where the economy is driven by skilled labor

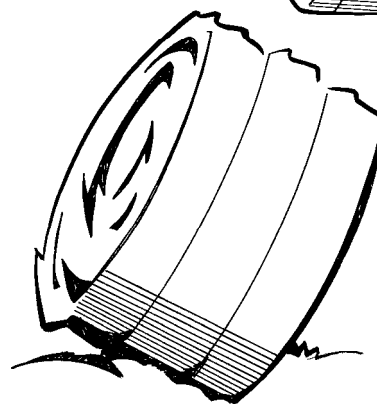
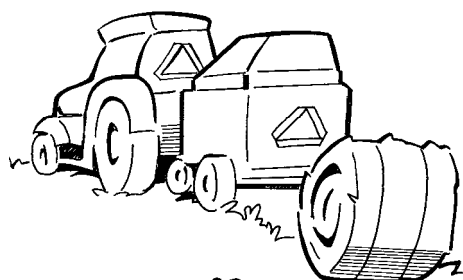
Using the Word Power vocabulary words at left, identify the type of technological advancement described.

- _____ Engine powered tractors
- _____ Information from this technology allows more controlled application of pesticides
- _____ Inserting plant genes with beneficial characteristics onto other plants to improve their performance
- _____ Decreases crop destruction so that 90% of crops are usable
- _____

WORD POWER

TYPES OF TECHNOLOGICAL ADVANCES

- MECHANICAL ADVANCES
- BIOTECHNOLOGY
- PESTICIDES
- GLOBAL POSITIONING SATELLITES



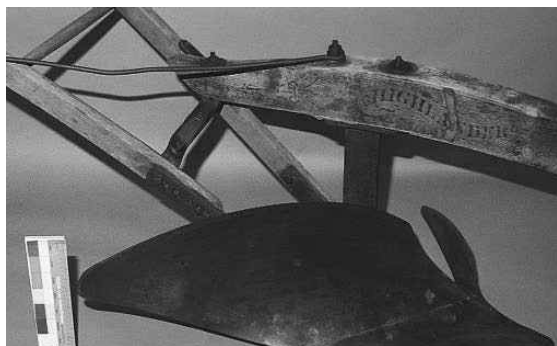
THINK FOR YOURSELF

In your own words, explain the reason food costs in the United States are the lowest in the world.

NAME _____

ACTIVITY 2 — COMPARE / CONTRAST AGRICULTURE TECHNOLOGY ?

EARLY PLOWS



MODERN PLOWS



COMPARE / CONTRAST

Identify two differences and similarities between early plows and modern plows.

DIFFERENCES

1. _____

2. _____

SIMILARITIES

1. _____

2. _____

NATIONAL SCIENCE STANDARD

- Science and Technology: Abilities of technological design

OBJECTIVES

The student will:

1. identify the risk and benefits of crop protection.
2. calculate the economic benefits of crop protection.

BACKGROUND

To grow the most amount of food as possible on the limited land resource, many farmers use crop protection chemicals called pesticides. If left untreated, weeds and insects would decrease food production by half.

3 KINDS OF PESTICIDES

- HERBICIDES
(CONTROL WEEDS)
- INSECTICIDES
(CONTROL INSECTS)
- FUNGICIDES
(CONTROL FUNGUS)

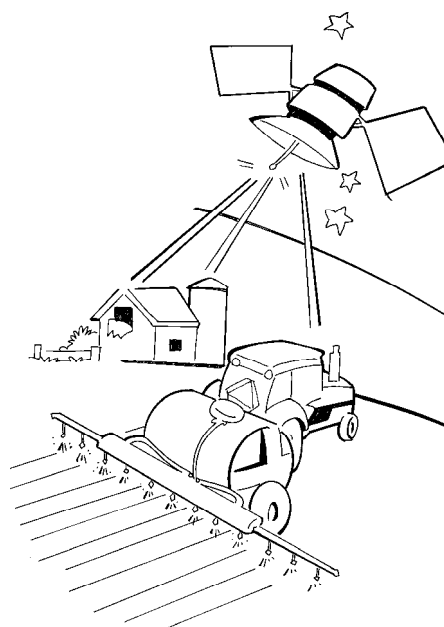
Herbicide use is only 60 years old, but societal changes have occurred that make it impossible to return to previous weed control practices. The amount of labor required to prevent yield loss would be an estimated 70 million workers. Migration of workers from rural areas has created shortages of farm workers.

The average wage rate for farm workers has increased by 7000% in the last 60 years. Farmers who paid \$10/acre for hand weeding in the 1940s would now face a labor cost of \$700/acre. The use of herbicides at \$30-\$50/acre remains the most cost-effective alternative.

Every activity carries some risk and some benefits. Sometimes the benefits so outweigh the risks we proceed without a second thought. We cannot prove with absolute certainty that there is no health risk associated with a chemical. What scientists and government officials do is attempt to estimate relative potential risk of a pesticide based on extensive testing and measure them against known benefits.

Pesticides are thoroughly tested for safety:

- Only 1 in 20,000 chemicals makes it from the lab to the farmer's field.
- Each pesticide is tested by up to 120 different safety tests.
- It takes 8-10 years for a chemical to be approved as a pesticide.



BACKGROUND, CONTINUED...

The Environmental Protection Agency (EPA) allows a pesticide to be used only when it is shown to pose negligible risk to human health and the environment. The EPA determines the greatest amount of residue that can be consumed safely, and then sets a limit of 100 to 1,000 times less than this amount.

In an ideal world—one where weeds, insects, and disease do not compete with crops for scarce water, sun, light, space, and soil nutrients—pesticides would not be required. Under real world conditions, however, pesticides play an essential role enabling farmers to produce sufficient quantities of food and fiber economically and safely.



Eliminating agricultural chemicals also means that the consumption of healthy fruits and vegetables would be limited due to decrease in supply and increase in cost.

The average American life expectancy has increased by nine years in the 40 years that pesticides have been used.

Minimizing the Risk

To decrease the risks associated with pesticides, the law requires that pesticides be used only in the manner indicated on the label. Many professionals who apply pesticides attend training. The management system, **Integrated Pest Management**, is used by farmers to insure pesticides are being used properly. It includes careful monitoring of pests and weeds with the use of a mixture of control methods such as natural predators, crop rotation and chemicals.

Risks

Spills resulting from misuse of pesticides exposing people to large doses in a concentrated form.

Increase human risk of disease by no more than one in one million.

Benefits

Protect the farmers investment in seed, soil, labor and other crop inputs

Consumers benefit from a daily bountiful supply of relatively inexpensive, healthy and wholesome farm produce.

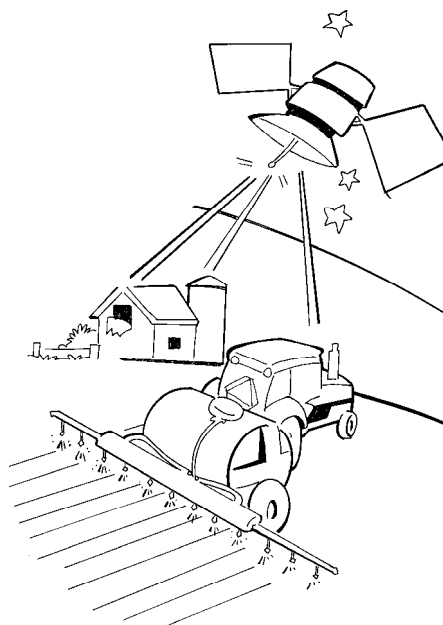
BACKGROUND, CONTINUED...

Satellite Technology

Global Positioning Satellite (GPS) technology was originally developed for the U.S. Department of Defense, but it has found many civil uses, including agriculture.

GPS uses a satellite in outer space to take special pictures of a farmer's field. Different parts of a farmer's fields have different needs.

The field monitor can determine a farmer's yield (the amount of food grown in a specific area). If the yield is adequate, the farmer knows he does not have a pest problem, which in turn eliminates the unnecessarily spraying pesticides. GPS as a navigational tool can also be used to direct a combine to harvest a field without a driver!



INSTRUCTIONAL PROCEDURE

1. Review background information.
2. Discuss with students how some words are created from combinations of other words. An example is the word pesticide. The root "cide" means "to kill." When combined with the word "pest" it means to kill pests.
3. Ask the students to give the meaning of "risk" and "benefit". Have students give examples of different actions and list the different risks and benefits of them.
4. Discuss how some common daily activities carries risks to which we rarely give any thought.
5. Have the students complete Activity 1 and Activity 2.

ASSESSMENT

1. Discuss with students what it would be like weed a field by hand—hot, dirty, physically exhausting—compared with using pesticides.
2. Using the pictures in Activity 2, discuss what protection pesticides give to a farmer's crops.

NAME _____

ACTIVITY 1: THE COST OF CROP PROTECTION

THINK FOR YOURSELF

The average U.S. farm in 2003 was 441 acres. With the following figures calculate the cost of farming with and without herbicides.

1. In 1940 it cost \$10.00 to hand weed one acre of farmland. How much would it have cost to weed 5 acres of soybeans?
2. It requires 90 hours of labor to weed one acre of farmland. At today wage rates, it costs \$700 to hand weed one acre of farmland. How much would it cost to weed 5 acres of soybeans?
3. Modern farmers use herbicides to control weed growth. On average farmers use 2 pounds of the active herbicide ingredient at a cost of \$30.00 per acre. How much would it cost to treat 5 acres of soybeans?
4. Discuss what would happen to food costs if herbicides were not used? How would that affect your life?



FAST FACT

ONE ACRE IS ABOUT
THE SIZE OF A
FOOTBALL FIELD!

NAME _____

ACTIVITY 2 — RISKS VS. BENEFITS

WHICH ONE IS IT?

The use of pesticides has both risks and benefits. Identify whether each statement is a risk or benefit.

1. _____ More healthy fruits and vegetables are available for people to eat.
2. _____ If pesticides are used improperly, a farmer may become ill.
3. _____ Pesticides help the US have the most abundant supply of safe food in the world.
4. _____ Pesticides can lower crop productions costs for farmers.
5. _____ EPA strictly regulates allowable pesticide residues on food.
6. _____ Insecticides destroy disease-carrying insects.
7. _____ Excessive us of pesticides may run off into water the source or be blown onto other plants.



NAME _____

ACTIVITY 2 — RISKS VS. BENEFITS CONTINUED...

TRUE OR FALSE

Look at the Weedy Fields and Pest Portraits pictures.

Determine whether the following statements are true or false.

1. _____ Weeds can block needed sunlight from a newly sprouted corn.
2. _____ Insects can make a corn cob unfit to eat.
3. _____ Insects are only a problem above ground.
4. _____ Weeds will not interfere with proper air circulation needed to prevent disease.
5. _____ Insect are large and easy to detect by sight.

WEEDY FIELDS



PEST PORTRAITS



Above: Corn Borer Feeding



Above: Corn Borer



Above: Western Bean Cutworm



Above: Root Worm Damage



Above: Western Bean Cutworm Size

NATIONAL SCIENCE STANDARD

- Science and Technology: Abilities of technological design

OBJECTIVE

The student will identify what benefits technology can provide to agriculture.

BACKGROUND

Biotechnology

Understanding that the earth has a limited amount of land and soil (A Slice of Soil-grade 4/5) to grow food to feed our growing world population brings to light the importance of new technologies.

For nearly 300 years plant breeders have worked to create better crops. We have been genetically modifying the food supply for thousands of years. Modern corn bears little resemblance to the first corn, teosinte. Those early cobs were just one to two inches long with a few tiny kernels.



Modern plant biotechnology is a much more precise tool than traditional plant breeding. It allows researchers to select a gene with a specific trait—such as a taste or hardness—in one plant and move it to another.

With traditional plant breeding, many genes are transferred to create a new plant variety. Some of these genes carry desired traits, others carry unwanted traits that must be removed with still more breeding. Getting it right is often difficult.



In the US more than 50 biotech crops have been approved for sale in the US and Canada. The list includes enhanced soybeans, cotton, corn, canola, cantaloupe, papaya, potato, squash, sugar beets, and tomatoes.

Scientists can create plants that are resistant to chemicals that kill weeds, plants that produce chemicals to kill insects, plants that grow in poor dry soil, and plants that last longer after harvesting.

ABILITIES OF TECHNOLOGY IN AGRICULTURE (CONTINUED)

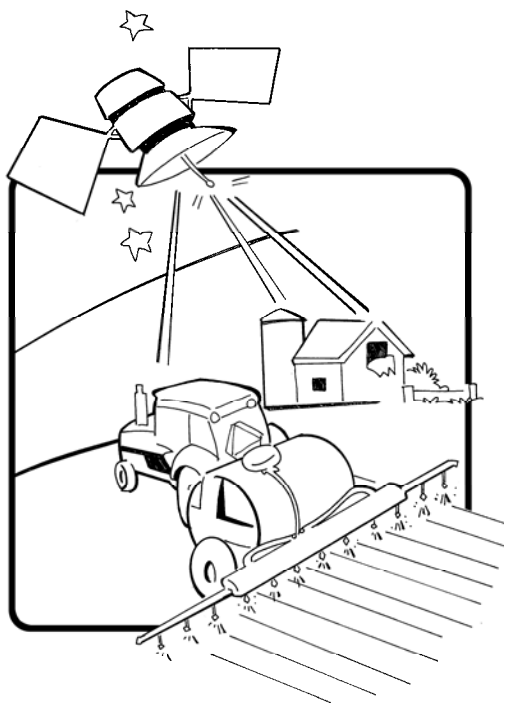
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WORD POWER

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gene *n.* The part of a chromosome that determines one of more characteristics that living things inherit from their parent.

pesticide *n.* Chemicals used to kill pests on crops.

satellite *n.* An object that orbits, or travels around, a planet and carry out a variety of jobs.

technology *n.* Using scientific discoveries and inventions to solve problems.

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NAME _____

ACTIVITY 1: THE COST OF CROP PROTECTION

WHAT TECHNOLOGY CAN DO:

___ Biotechnology can develop plants that are not destroyed by insects.

___ Biotechnology can develop plants that grow without much water

___ Biotechnology can provide rice high in beta-carotene to prevent vitamin A deficiency.

___ Biotechnology has developed new cooking oils higher in vitamin E

___ A GPS field monitor can determine the crop yield.

___ GPS can guide a combine around a field to harvest without the need for a driver.

IT'S EFFECT ON AGRICULTURE:

A. If a farmer's yield is high, he knows he doesn't have a pest problem so he won't spray unnecessary pesticides.

B. Developing countries could see a reduction in blindness due to vitamin A deficiency.

C. Reduced amount of insecticides would be used.

D. Decrease labor costs to harvest a crop.

E. Increase vitamin E in the US diet which has been shown to lower the risk of heart disease.

F. Can grow crops in dry areas increasing the amount of land available for food production.

